

Patent Claims

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1. Liquid-crystal switching element comprising a liquid-crystal layer having an initial alignment which is essentially parallel to the substrates and is essentially untwisted, at least one polariser, a device for generating an electric field, which is aligned essentially parallel to the substrates in the case of liquid-crystal materials of negative dielectric anisotropy and is aligned essentially perpendicular to the substrates in the case of liquid-crystal materials of positive dielectric anisotropy, and, if desired, at least one birefringent layer, characterised in that the liquid-crystal layer has an optical retardation $[(d \cdot \Delta n)_{LC}]$ in the range from $0.05 \mu\text{m}$ to $0.46 \mu\text{m}$.
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2. Liquid-crystal switching element according to Claim 1, characterised in that it contains at least one linear polariser.
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3. Liquid-crystal switching element according to at least one of Claims 1 and 2, characterised in that the twist angle of the liquid-crystal layer (ϕ) is in the range from -25° to $+25^\circ$.
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4. Liquid-crystal switching element according to at least one of Claims 1 to 3, characterised in that the optical retardation of the liquid-crystal layer is or can be switched from its initial value to essentially 0 nm .
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5. Liquid-crystal switching element according to at least one of Claims 1 to 4, characterised in that it is a transmissive or transfective liquid-crystal switching element.
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6. Liquid-crystal switching element according to at least one of Claims 1 to 5, characterised in that the optical retardation of the liquid-crystal layer is from $0.20 \mu\text{m}$ to $0.37 \mu\text{m}$.
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7. Liquid-crystal switching element according to at least one of Claims 1 to 6, characterised in that the optical retardation of the liquid-crystal layer is from $0.07 \mu\text{m}$ to $0.17 \mu\text{m}$.

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8. Liquid-crystal switching element according to at least one of Claims 1 to 7, characterised in that it contains at least one birefringent layer.

9. Liquid-crystal switching element according to Claim 8, characterised in that it contains a $\lambda/4$ layer, a $\lambda/2$ layer or two $\lambda/4$ layers.

10. Liquid-crystal switching element according to at least one of Claims 8 and 9, characterised in that the optical retardation of the birefringent layer or of the birefringent layers $[(d \cdot \Delta n)_{BL}]$ corresponds either to essentially half or essentially twice the optical retardation of the liquid-crystal layer $[(d \cdot \Delta n)_{LC}]$.

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11. Liquid-crystal switching element according to Claim 10, characterised in that the optical retardation of the liquid-crystal layer is from 0.20 μm to 0.37 μm , and the liquid-crystal switching element contains a $\lambda/4$ layer.

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12. Liquid-crystal switching element according to Claim 10, characterised in that the optical retardation of the liquid-crystal layer is from 0.07 μm to 0.17 μm , and the liquid-crystal switching element contains a $\lambda/2$ layer or two $\lambda/4$ layers.

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13. Liquid-crystal switching element according to at least one of Claims 1 to 7, characterised in that the switching element contains no birefringent layer.

14. Liquid-crystal switching element according to Claim 13, characterised in that the twist angle of the liquid-crystal layer, (ϕ) is from -6° to $+6^\circ$.

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15. Liquid-crystal switching element according to at least one of Claims 13 and 14, characterised in that the optical retardation of the liquid-crystal layer in the fully switched state is from 0 nm to 80 nm, preferably from 0 nm to 40 nm.

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16. Liquid-crystal switching element according to at least one of Claims 13 to 15, characterised in that the liquid-crystal layer has positive dielectric anisotropy.

17. Liquid-crystal switching element according to at least one of Claims 13 to 16, characterised in that it can be operated in normally white mode.

5 18. Liquid-crystal switching element according to at least one of Claims 13 to 17, characterised in that it is a reflective liquid-crystal switching element.

10 19. Liquid-crystal switching element according to at least one of Claims 13 to 17, characterised in that it is a transmissive liquid-crystal switching element.

15 20. Liquid-crystal switching element according to at least one of Claims 13 to 15, characterised in that the liquid-crystal layer has negative dielectric anisotropy.

20 21. Electro-optical liquid-crystal display device, characterised in that it contains a liquid-crystal switching element or a plurality of liquid-crystal switching elements according to at least one of Claims 1 to 20.

22. Electro-optical liquid-crystal display device according to Claim 21, characterised in that it contains a multiplicity of liquid-crystal switching elements, and these are arranged in matrix form.

25 23. Electro-optical liquid-crystal display device according to Claim 21 or 22, characterised in that the liquid-crystal switching elements are addressed by means of a matrix of active electrical switching elements.

30 24. Use of an electro-optical liquid-crystal switching element or a plurality of electro-optical liquid-crystal switching elements according to at least one of Claims 1 to 20 in a liquid-crystal display device.

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